Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Currently amended) A method for analyzing a circuit network, comprising:

determining nodal voltages corresponding to nodes of a circuit network and branch currents corresponding to branches of the circuit network, wherein the determining comprises:

representing the [[a]] circuit network [[by]] using a matrix of nodes having fine nodes and coarse nodes that correspond to the nodes of the circuit network, wherein the matrix of nodes represents a system matrix of a matrix equation for determining the nodal voltages and the branch currents;

applying an adaptive coarse grid construction procedure to assign grid nodes in the matrix as either coarse grid nodes or fine grid nodes according to (1) circuit activities and (2) a matrix structure of the matrix to construct a plurality of levels of grids with different numbers of nodes to respectively represent the circuit network; [[and]]

dynamically changing designations of active and inactive regions of the circuit network according to circuit activities at different times;

applying iterative smoothing operations at selected local fine grids corresponding to active regions at a finest level obtained in the adaptive coarse grid construction procedure;

computing a residual value of an error after the applying of the iterative smoothing operations at the finest level;

comparing the residual value to a pre-determined threshold; and

responsive to a result of the comparing, using the matrix equation to determine the nodal voltages and the branch currents; and

identifying operational characteristics of the circuit network based on the determined node voltages and branch currents;

wherein the determining nodal voltages and branch currents and the identifying operational characteristics are performed by one or more computer processors.

2. (Original) The method as in 1, wherein the coarse grid nodes are divided into non-adaptive coarse nodes which are selected according to the matrix structure, and adaptive coarse nodes which are selected according to circuit activities.

3. (Currently Amended) The method as in claim 2, wherein[[,]] in assigning non-adaptive coarse nodes, a node with a maximum potential in its degree is selected as a first non-adaptive coarse node and each neighboring node of the first non-adaptive coarse node is temporality assigned as a fine node, and wherein a potential of each neighboring node of the first non-adaptive coarse node is increased by one unit before a next level of assigning coarse and fine grid nodes so that each fine node has at least one neighboring coarse node upon completion of assigning non-adaptive coarse nodes.

4. (Original) The method as in claim 2, wherein an adaptive coarse node is selected according to a first-order derivative of a nodal voltage.

5. (Original) The method as in claim 4, wherein a coarse node is selected as an adaptive coarse node when the first-order derivative the coarse node is greater than a threshold value.

6. (Currently amended) The method as in claim 5, wherein the determining nodal voltages and branch currents further comprises ~~comprising~~ selecting adaptive coarse nodes in a level that is not the finest level.

7. (Currently amended) The method as in claim 1, after the iterative smoothing operations in a level, wherein the determining nodal voltages and branch currents further comprises ~~comprising~~:

applying a restriction mapping of nodes in the level to a next level with less nodes;

performing iterative smoothing operations again at the next level; and

repeating the restriction mapping and the iterative smoothing operations until reaching a level of nodes which are solvable by a direct matrix solving method such as a Gaussian elimination method.

8. (Currently amended) The method as in claim 1, after the iterative smoothing operations in a level, <u>wherein the determining nodal voltages and branch currents</u> further <u>comprises</u> ~~comprising~~:

applying an interpolation mapping of nodes in the level to a next level with more nodes;

performing iterative smoothing operations again at the next level; and

repeating the interpolation mapping and the iterative smoothing operations until reaching the finest level of nodes.

9. (Currently amended) The method as in claim 8, <u>the determining nodal voltages and branch currents</u> further <u>comprises</u> ~~comprising~~:

~~computing a residual value of an error after the iterative smoothing operations at the finest level;~~

~~comparing the residual value to a pre-determined threshold;~~

terminating any further processing when the residual value is less than the threshold; and

when residual value is greater than the threshold, the method further comprising:

applying a restriction mapping of nodes in the finest level to a next coarser level with less nodes,

performing iterative smoothing operations again at the next coarser level; and

repeating the restriction mapping and the iterative smoothing operations until reaching a coarsest level of nodes which is solvable by a direct matrix solving method such as a Gaussian elimination method,

applying an interpolation mapping of nodes in the coarsest level to a next finer level with more nodes,

performing iterative smoothing operations at the next finer level,

repeating the interpolation mapping and the iterative smoothing operations until reaching the finest level of nodes, and

repeating the restriction mapping, the interpolation mapping and the respective iterative smoothing operation at different levels until the residual value at the finest level is less than the threshold.

10. (Canceled.)

11. (Currently amended) The method as in claim 1 [[10]], the determining nodal voltages and branch currents further comprises ~~comprising~~ applying iterative smoothing operations in active regions more frequently in time than in inactive regions.

12. (Currently amended) The method as in claim 1, the determining nodal voltages and branch currents further comprises ~~comprising:~~ in a passive linear circuit, applying different models to passive circuits exhibiting resistance and capacitance without inductance and passive circuits exhibiting inductance.

13. (Currently amended) The method as in claim 12, wherein the determining nodal voltages and branch currents further comprises ~~comprising~~ separating nodal voltages and branch currents into different vectors during processing to make [[a]]the system matrix in the matrix equation to be symmetric and positive definite.

14. (Currently amended) A method for analyzing a circuit network, comprising:

determining nodal voltages corresponding to nodes of a circuit network and branch currents corresponding to branches of the circuit network, wherein the determining comprises:

representing [[a]] the circuit network [[by]] using a plurality of levels of grids with different numbers of nodes to represent the circuit network according to an algebraic multigrid method, wherein the nodes of the levels of grids correspond to the nodes of the circuit network;

assigning a portion of a given level of grids as active local grids and a remainder of the given level of grids as inactive local grids, wherein the active local grids correspond to active circuit regions in the circuit network; and

applying a restriction mapping from [[one]]a given level of grids to a next coarser level of grids to propagate computation results of the [[one]]given level of grids to the next coarse level of grids;

applying an interpolation mapping from [[one]]a given level of grids to a next finer level of grids to propagate computation results of the [[one]]given level of grids to the next finer level of grids;

performing an iterative smoothing operation at each level of grids to obtain computation results of each level of grids comprising states of nodes in each level of grids, wherein the iterative smoothing operation is performed in a given active local grid more frequently than in a given inactive grid; and

repeating (1) the restriction mapping and the iterative smoothing operation from the finest level of grids to the coarsest level of grids and (2) the interpolation mapping and the iterative smoothing operation from coarsest level of grids back to the finest level of grids for at least one time to obtain a solution to a matrix equation for corresponding nodes of the circuit network, wherein the repeating is performed until a residual error of the solution is less than a predetermined threshold, wherein the solution comprises the nodal voltages and the branch currents; and

identifying operational characteristics of the circuit network based on the determined nodal voltages and branch currents;

wherein the determining nodal voltages and branch currents and the identifying operational characteristics are performed by one or more computer processors.

15. (Currently Amended) The method as in claim 14, wherein the coarsest level of grids [[is]]comprises a level of grids where a given matrix equation for corresponding nodes in the coarsest level of grids is solvable by a direct matrix method such as the Gaussian elimination method.

16. (Currently Amended) The method as in claim 14, wherein at least one of the levels of grids includes nodes corresponding to the active ~~only selected~~ circuit regions in the circuit network ~~that are active~~ and does not include nodes corresponding to inactive circuit regions in the circuit network.

17. (Currently amended) The method as in claim 14, wherein the determining nodal voltages and branch currents further comprises ~~comprising~~:

assigning regions in the finest level of grids with nodes corresponding to the active circuit regions in the circuit network as active local fine grids; and

performing the iterative smoothing operation only in the active local fine grids in the finest level of grids to obtain computation results of the finest level of grids.

18. (Canceled.)

19. (Currently amended) The method as in claim 14, wherein the determining nodal voltages and branch currents further comprises ~~comprising~~ applying an adaptive coarse grid construction procedure to assign [[grid]] nodes of levels of grids in the matrix equation as either coarse grid nodes or fine grid nodes.

20. (Currently Amended) The method as in claim 19, wherein a given coarse node is assigned by:

assigning a node with a maximum potential to its degree as a first coarse node and all neighboring nodes as initial fine nodes;

for each of the initial fine nodes, increasing a potential of each of neighboring nodes by one unit;

assigning a node which has a maximum potential among other nodes except for the first coarse node as a second coarse node; and

repeating the assigning for nodes that are not assigned as coarse nodes until all nodes are assigned.

21. (Original) The method as in claim 19, wherein the coarse nodes are selected according to their values of a first-order derivative of a nodal voltage.

22. (Currently amended) A method for analyzing a circuit network, comprising:

determining nodal voltages corresponding to nodes of a circuit network and branch currents corresponding to branches of the circuit network, wherein the determining comprises:

applying an algebraic multigrid method to a matrix representative of ~~a~~ the circuit network to construct a plurality of matrices with different degrees of coarsening grids, wherein the coarsening grids correspond to the nodes of the circuit network, and wherein the matrix representative of the circuit network represents a system matrix of a matrix equation for determining the nodal voltages and the branch currents;

representing regions in the circuit network exhibiting active circuit activities with active grids and regions in the circuit network exhibiting less active circuit activities with inactive grids; ~~and~~

performing an iterative smoothing operation in [[an]]a given active grid more frequently than in [[an]]a given inactive grid to reduce an amount of computation; and

responsive to performing the iterative smoothing operation at a given grid having a finest degree of coarsening until a residual error of a solution of the matrix equation is less than

a predetermined threshold, using the solution of the matrix equation to determine the nodal voltages and the branch currents; and

identifying operational characteristics of the circuit network based on the determined nodal voltages and branch currents;

wherein the determining nodal voltages and branch currents and the identifying operational characteristics are performed by one or more computer processors.

23. (Currently amended) The method as in claim 22, wherein the determining nodal voltages and branch currents further comprises ~~comprising~~:

applying a restriction mapping of nodes in a given coarse grid to a next coarser grid;

performing the iterative smoothing operation at the next coarser grid; and

repeating the restriction mapping and the iterative smoothing operation until reaching the coarsest grid which has a corresponding matrix equation that is solvable by a direct matrix solving method such as a Gaussian elimination method.

24. (Currently amended) The method as in claim 22, wherein the determining nodal voltages and branch currents further comprises ~~comprising~~:

applying an interpolation mapping of nodes in [[one]]a given grid to a next finer grid;

performing the iterative smoothing operation at the next finer level; and

repeating the interpolation mapping and the iterative smoothing operation until reaching the finest grid.

25. (Currently amended) An article comprising a machine-readable medium that stores machine-executable instructions, the instructions causing a machine to:

determine nodal voltages corresponding to nodes of a circuit network and branch currents corresponding to branches of the circuit network, wherein the determination comprises:

apply an algebraic multigrid method to a matrix representative of ~~a~~ the circuit network to construct a plurality of matrices with different degrees of coarsening grids, wherein

the coarsening grids correspond to the nodes of the circuit network, and wherein the matrix representative of the circuit network represents a system matrix of a matrix equation for determining the nodal voltages and the branch currents;

divide the circuit network into active regions and inactive regions according to circuit activities; ~~and~~

perform an iterative smoothing operation in [[an]]a given active region more frequently than in [[an]]a given inactive region to solve for a corresponding matrix equation of each grid and to map a computation result of each grid to a next finer or coarser grid until a residual error of a solution corresponding to a grid having a finest degree of coarsening is less than a pre-determined threshold; and

use the solution of the matrix equation to determine the nodal voltages and the branch currents; and

identify operational characteristics of the circuit network based on the determined nodal voltages and branch currents.

26. (Canceled.)

27. (New) The method as in claim 1, wherein the operational characteristics comprise at least one of voltage drop, voltage oscillation, electromigration, effects of self and mutual inductances in the network circuit, or coupling effects with electromagnetic retardation for high-frequency chip-package-board assemblies.

28. (New) The method as in claim 10, wherein the operational characteristics comprise at least one of voltage drop, voltage oscillation, electromigration, effects of self and mutual inductances in the network circuit, or coupling effects with electromagnetic retardation for high-frequency chip-package-board assemblies.

29. (New) The method as in claim 22, wherein the operational characteristics comprise at least one of voltage drop, voltage oscillation, electromigration, effects of self and mutual inductances in the network circuit, or coupling effects with electromagnetic retardation for high-frequency chip-package-board assemblies.

30. (New) The method as in claim 25, wherein the operational characteristics comprise at least one of voltage drop, voltage oscillation, electromigration, effects of self and mutual inductances in the network circuit, or coupling effects with electromagnetic retardation for high-frequency chip-package-board assemblies.